CLAIMS

WHAT IS CLAIMED:

1.   A processing line, comprising:

a processing tool configured to process workpieces;

5   a metrology tool configured to measure an output characteristic of selected

workpieces in accordance with a sampling plan;

a tool state monitor configured to observe at least one tool state variable value during

the processing of a selected workpiece in the processing tool; and

a sampling controller configured to receive the observed tool state variable value and

10   determine the sampling plan for the metrology tool based on the observed tool

state variable value.

2.   The processing line of claim 1, wherein the sampling controller is further

configured to compare the observed tool state variable value to a predetermined threshold and

15   change the sampling plan responsive to the observed tool state variable value exceeding the

predetermined threshold.

3.   The processing line of claim 1, wherein the sampling controller is further

configured to identify a trend in the observed tool state variable values associated with the

20   processing of a plurality of workpieces and change the sampling plan responsive to

identifying the trend.

4.   The processing line of claim 1, wherein the sampling controller is further

configured to generate an expected tool state variable value associated with the processing of

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the particular workpiece, compare the expected tool state variable value to the observed tool state variable value, and determine the sampling plan based on the comparison.

5.   The processing line of claim 1, wherein the sampling controller is configured to define a plurality of bins, each bin having an associated range of tool state variable values, associate the observed tool state variable value with one of the bins having a range encompassing the observed tool state variable value, and determine the sampling plan based on the associated bin.

6.   The processing line of claim 1, wherein the processing tool is configured to process single workpieces, and the sampling plan comprises a sampling frequency for measuring subsequent workpieces processed in the processing tool.

7.   The processing line of claim 1, wherein the processing tool is configured to concurrently process a set of workpieces, and the sampling plan comprises a number of workpieces in the set to be measured by the metrology tool.

8.   The processing line of claim 1, wherein the workpieces comprise semiconductor wafers.

9.   A processing line, comprising:

an etch tool configured to etch process layers;

a metrology tool configured to measure an output characteristic of selected etched process layers in accordance with a sampling plan;

a tool state monitor configured to observe at least one tool state variable value during

the etching of a particular process layer in the etch tool; and

a sampling controller configured to receive the observed tool state variable value and

determine the sampling plan for the metrology tool based on the observed tool

5   state variable value.

10.   The processing line of claim 9, wherein the sampling controller is further

configured to compare the observed tool state variable value to a predetermined threshold and

change the sampling plan responsive to the observed tool state variable value exceeding the

10   predetermined threshold.

11.   The processing line of claim 9, wherein the sampling controller is further

configured to identify a trend in the observed tool state variable values associated with the

processing of a plurality of process layers and change the sampling plan responsive to

15   identifying the trend.

12.   The processing line of claim 9, wherein the sampling controller is further

configured to generate an expected tool state variable value associated with the processing of

the particular process layer, compare the expected tool state variable value to the observed

20   tool state variable value, and determine the sampling plan based on the comparison.

13.   The processing line of claim 9, wherein the sampling controller is configured

to define a plurality of bins, each bin having an associated range of tool state variable values,

associate the observed tool state variable value with one of the bins having a range

encompassing the observed tool state variable value, and determine the sampling plan based on the associated bin.

14.   The processing line of claim 9, wherein the sampling plan comprises a sampling frequency for measuring subsequent process layers processed in the etch tool.

15.   The processing line of claim 9, wherein the sampling plan comprises a number of process layers in a set of wafers on which the process layers are formed to be measured by the metrology tool.

16.   The processing line of claim 9, wherein the tool state variable value comprises at least one of a pressure value, a temperature value, a plasma power value, and a reactant gas flow rate value.

17.   A method for processing workpieces, comprising:

processing a plurality of workpieces in a processing tool;

measuring a characteristic of selected workpieces in accordance with a sampling plan;

observing at least one tool state variable value during the processing of a particular workpiece in the processing tool; and

determining the sampling plan based on the observed tool state variable value.

18.   The method of claim 1, wherein determining the sampling plan further comprises:

comparing the observed tool state variable value to a predetermined threshold; and

changing the sampling plan responsive to the observed tool state variable value

exceeding the predetermined threshold.

19.   The method of claim 17, wherein determining the sampling plan further

5   comprises:

identifying a trend in the observed tool state variable values associated with the

processing of a plurality of workpieces; and

changing the sampling plan responsive to identifying the trend.

20.   The method of claim 17, wherein determining the sampling plan further

10   comprises:

generating an expected tool state variable value associated with the processing of the

particular workpiece;

comparing the expected tool state variable value to the observed tool state variable

15   value; and

determining the sampling plan based on the comparison.

21.   The method of claim 17, wherein determining the sampling plan further

comprises:

20   defining a plurality of bins, each bin having an associated range of tool state variable

values;

associating the observed tool state variable value with one of the bins having a range

encompassing the observed tool state variable value; and

determining the sampling plan based on the associated bin.

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22. The method of claim 17, wherein the processing tool is configured to process single workpieces, and determining the sampling plan further comprises determining a sampling frequency for measuring subsequent workpieces processed in the processing tool.

23. The method of claim 17, wherein the processing tool is configured to concurrently process a set of workpieces, and determining the sampling plan further comprises determining a number of workpieces in the set to be measured by the metrology tool.

24. The method of claim 17, wherein processing the plurality of workpieces further comprises processing a plurality of semiconductor wafers.

25. A method for processing wafers, comprising:

etching a plurality of process layers;

measuring an output characteristic of the etched process layers in accordance with a sampling plan;

observing at least one tool state variable value during the etching of a particular process layer; and

determining the sampling plan based on the observed tool state variable value.

26. The method of claim 25, wherein determining the sampling plan further comprises:

comparing the observed tool state variable value to a predetermined threshold; and

changing the sampling plan responsive to the observed tool state variable value exceeding the predetermined threshold.

27.   The method of claim 25, wherein determining the sampling plan further comprises:

    identifying a trend in the observed tool state variable values associated with the

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        processing of a plurality of process layers; and

    changing the sampling plan responsive to identifying the trend.

28.   The method of claim 25, wherein determining the sampling plan further comprises:

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    generating an expected tool state variable value associated with the processing of the

        particular process layer;

    comparing the expected tool state variable value to the observed tool state variable

        value; and

    determining the sampling plan based on the comparison.

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29.   The method of claim 25, wherein determining the sampling plan further comprises:

    defining a plurality of bins, each bin having an associated range of tool state variable

        values;

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    associating the observed tool state variable value with one of the bins having a range

        encompassing the observed tool state variable value; and

    determining the sampling plan based on the associated bin.

30.   The method of claim 25, wherein determining the sampling plan further comprises determining a sampling frequency for measuring subsequent process layers processed in the etch tool.

5   31.   The method of claim 25, wherein determining the sampling plan further comprises determining a number of process layers in a set of wafers on which the process layers are formed to be measured by the metrology tool.

32.   The method line of claim 25, wherein observing the tool state variable value comprises observing at least one of a pressure value, a temperature value, a plasma power value, and a reactant gas flow rate value.

33.   A processing line, comprising:

means for processing a plurality of workpieces;

means for measuring a characteristic of selected workpieces in accordance with a
        sampling plan;

means for observing at least one tool state variable value during the processing of a
        particular workpiece; and

means for determining the sampling plan based on the observed tool state variable value.

34.   A processing line, comprising:

means for etching process layers;

means for measuring an output characteristic of the etched process layers in
        accordance with a sampling plan;

means for observing at least one tool state variable value during the etching of a

particular process layer; and

means for determining the sampling plan based on the observed tool state variable

value.

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